RESOURCE MANAGEMENT WITHIN A PARTICIPANT OF A WIRELESS-COMMUNICATIONS NETWORK

The invention relates to participants in wireless communications networks, such as base stations and mobile telephones.

A wireless-communications network comprises one or more subscriber units and one or more base stations for conducting communications with subscriber units. Each base station will normally be capable of handling simultaneously calls made by a plurality of subscriber units in the vicinity of the base station. Typically, the subscriber units will be mobile telephones. The subscriber units can be termed "users" of the base stations.

Typically, a modern base station will perform some of its signal processing in the analogue domain and some of its signal processing in the digital domain. For example, in the context of signal reception by a UMTS (Universal Mobile Telecommunications System) base station, the analogue signal processing will usually comprise the down conversion of a received RF (radio frequency) signal to base-band with the digital signal processing involving the recovery of an information signal from the base-band signal by descrambling and despreading, etc. In the context of signal transmission by a base station, the digital signal processing will typically comprise the spreading and scrambling of an information signal with the analogue signal processing involving the modulation of the resulting spread-spectrum signal onto an RF carrier wave for transmission from an antenna. Obviously, the foregoing description gives only the briefest of outlines of how signal processing operations can be divided between the analogue and digital domains and many variations will exist. For example, it is possible for part of the conversion between base-band and RF to be done digitally by digitally converting a signal between base-band and IF (intermediate frequency) with the conversion between IF and RF being performed in the analogue domain.

In a so-called 3G (third generation) wireless communications network, for example a network conforming to the UMTS (Universal Mobile Telephone System) standards, the amount of digital processing that a base station has to perform on signals being sent to, and

received from, users can be burdensome, particularly where the number of users serviced by a given base station is large. Much effort has been expended on maximising the base-band processing throughput of base stations and subscriber units in 3G networks.

Traditionally, the design proposed for a 3G base station requires hardware elements that are specifically designed to carry out particular digital (and normally base-band) signal processing tasks at high speed. However, it is also possible to provide a base station with one or more high-speed, general-purpose signal processors which can be programmed with appropriate software for carrying out the digital processing functions of the base station, including those that would be performed by the specially designed hardware elements in the traditional type of base station design. A base station of this type is sometimes referred to as a soft base station. Where a plurality of such general purpose signal processors are employed in a soft base station, they are often referred to collectively as the base-band processing resources of the soft base station since between them the processors have to carry out the majority of the base-band processing of the base station.

One aim of the present invention is to provide for an improvement in the efficiency with which digital processing resources are used within a wireless-communications network participant, such as a soft base station.

According to one aspect, the invention provides a participant for a wireless-communications network, comprising digital signal processing means for performing digital signal processing operations on communications signals received at, or to be transmitted from, the participant, a schedule of sequences of digital signal processing operations to be performed by the digital signal processing means and specifying the times at which the sequences are to be performed, an update list of updates that need to be applied to the schedule and a controller for determining the content of the updates, wherein the digital signal processing means is arranged to check, upon completion of each of the sequences, the update list for an update that is due to be applied to the schedule.

The invention also consists in a method of controlling the performance of digital signal processing operations within a participant of a wireless-communications network, the

method comprising accessing a schedule of sequences of digital signal processing operations that need to be performed on signals received at, or to be transmitted from, the participant, performing the sequence of digital signal processing operations in the schedule that needs to be performed at the current time, checking, at the end of the current sequence, an update list for updates that need to be applied to the schedule at the present time and updating the schedule with any updates that need to be applied at this time.

Thus, the invention allows updates to the schedule of digital signal processing operations to be made with less disruption to the flow of the digital signal processing operations (which may be required to be executed in real-time).

The digital signal processing means and the controller can be program code that is executed on data processing resources of the participant with the schedule and the update list being held in data storage resources of the participant. In such an embodiment, the controller and the digital signal processing means can be referred to as a controller task and a digital signal processing task, respectively.

In a preferred embodiment, the participant is a soft basestation in a UMTS network.

By way of example only, an embodiment of the invention will now be described with reference to the accompanying figures, in which:

Figure 1 is a schematic view of a UMTS soft basestation; and

Figure 2 is a schematic illustration of the signal processing task management scheme employed within the basestation of Figure 1.

The UMTS soft basestation 10 shown in Figure 1 basically comprises an RF section 12 and a base-band section 14. The purpose of the RF section is to frequency convert signals travelling between the base-band section 14 and the antenna 16. The RF section 12 downconverts radio frequency (RF) signals received at antenna 16 for processing by the base-band section 14 and upconverts base-band signals from section 14 to RF signals for

transmission from the antenna 16. The basestation 10 is a so-called soft basestation which means that substantially all of its base-band processing is done in the digital domain using software. The base-band section 14 comprises a group of DSPs, of which two, 18 and 20, are shown, a general-purpose microprocessor 22 and a memory system 24. The purpose of the microprocessor 22 is to exert overall control over the functions of the basestation. The DSPs perform the base-band signal processing operations that need to be done on the signals that are received from, or destined for, the RF section 12. The types of base-band signal processing operations carried out by the DSPs include code spreading and despreading, scrambling and descrambling, turbo coding, Viterbi decoding, etc.

Figure 2 shows how base-band signal processing is performed and controlled within the base-band section 14 from the perspective of the software that is run on the DSPs and the microprocessor 22. The microprocessor 22 runs a base-band control (BBC) task 26 that is responsible for overall control of the base-band signal processing. In Figure 2, the DSPs are represented by a DSP task 28 which is responsible for performing the base-band digital signal processing tasks that are required.

The base-band digital signal processing tasks that are performed by the DSP task 28 are organised according to a task schedule 30 which is maintained in memory 24. The schedule 30 comprises a series of sequences, such as 32, of base-band digital signal processing tasks. The schedule 30 specifies the time at which each of the sequences is to be performed. The start times of the task sequences of the schedule 30 are marked t0, t1, t2, t3, t4, t5 and t6 in Figure 2.

The BBC task 26 is responsible for making changes to the content of the schedule 30. The BBC task 26 maintains a list 34 of updates that need to be made to the task schedule 30. The BBC task 26 is run on the microprocessor 22 and the microprocessor 22 can only communicate with DSPs 18, 20 through a simple message-based interface. This allows the asynchronous control processing to be decoupled from the synchronous signal processing. Hence, the BBC task 26 cannot implement updates to the schedule 30 directly and resorts to the agency of the update list 34 to achieve this goal.

Each entry in the list 34 contains an update for the schedule 30 and a time at which the update must be implemented. The entries in the list 34 are prioritised according to their specified implementation times. The updates in list 34 are applied to the schedule 30 by the DSP task 28. The DSP task 28 checks the list 34 at the end of processing each sequence of the schedule in order to determine if there are any updates in the list 34 that the DSP task 28 needs to implement at the present time.

An example of the system in operation will now be given.

At time t0, the DSP task 28 accesses the schedule 30 as shown by arrow a. The DSP task 28 then proceeds to perform, as indicated by arrow b, the base-band signal processing tasks specified in the sequence 32 that is associated with time t0. After processing the final task 36 in sequence 32, the DSP task 28 checks, as indicated by arrow c, list 34 to determine if there are any updates that need to be made to the schedule 30 at this time. The updates needed at this time are implemented as indicated by arrow d. Entries are added to the update list 34 by the BBC task 26 as indicated by arrow e. The BBC task 26 is also responsible for sorting the entries within list 34 into a prioritised order according the implementation times assigned to the entries.

Thus, the impact of the process of incorporating changes into the schedule of base-band processing tasks upon the performance of the (often time critical) base-band signal processing tasks themselves is reduced because the changes to the schedule are only implemented once the base-band signal processing tasks that need to performed at a given point in time have been carried out.